OCR (B) Chemistry A-Level

DM3 - Redox

Flashcards

What is a half-cell?

What is a half-cell?

A half-cell contains the chemical species present in a redox half equation.

What is a metal/metal ion half-cell?

What is a metal/metal ion half-cell?

- A half cell where a metal rod is dipped into a solution containing an ion of the same metal.
- An equilibrium will be set up at the boundary where the metal is in contact with its ions.
- An example of the redox reaction happening at a metal/metal ion half-cell:

$$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$$

What is an ion/ion half-cell?

What is an ion/ion half-cell?

- An ion/ion half cell contains a solution of ions of the same element but of different oxidation states e.g. Fe^{2+} and Fe^{3+}:

$$Fe^{3+}_{(aq)} + e^- \rightleftharpoons Fe^{2+}_{(aq)}$$

- The electrode is usually graphite or platinum.

How do you balance a half equation?

How do you balance two half equations?

Half equations:

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ (oxidised)

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ (reduced)

Balance so that the number of electrons are the same:

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$

$2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$

How do you combine two balanced half equations?

How do you combine two balanced half equations?

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ $\quad\quad$ $2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$

- Combine the equations into one and cancel any common species that appear on both sides of the equation i.e. electrons, water and hydrogen ions.

$Zn_{(s)} + 2Fe^{3+}_{(aq)} + \cancel{2e^-} \rightarrow Zn^{2+}_{(aq)} + \cancel{2e^-} + 2Fe^{2+}_{(aq)}$

- Overall redox equation:

$Zn_{(s)} + 2Fe^{3+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Fe^{2+}_{(aq)}$

What is *standard electrode potential*?

What is *standard electrode potential*?

The EMF/voltmeter reading when a half-cell of interest is connected to a hydrogen half-cell via a salt bridge, with all solutions having a concentration of 1 mol dm^{-3}, under standard conditions (101 (or 100) kPa and 298 K).

What is a hydrogen half-cell?

What is a hydrogen half-cell?

- A half-cell containing hydrogen gas and a solution containing hydrogen ions.
- An inert platinum electrode is used to allow electrons into and out of the half cell.

$$2H^+_{(aq)} + 2e^- \rightleftharpoons H_{2(g)}$$

How do you use standard electrode potentials to calculate the standard cell potential?

How do you use standard electrode potentials to calculate the standard cell potential, E^{θ}_{cell}?

$$E^{\theta}_{cell} = E^{\theta}_{(positive\ electrode)} - E^{\theta}_{(negative\ electrode)}$$

What is an electrochemical cell?

What is an electrochemical cell?

- Two different half-cells are connected by a salt bridge, with their electrodes connected to a voltmeter (measures EMF/cell potential). This allows the flow of electrons.
- It generates electrical energy from chemical redox reactions.

What does an electrochemical cell look like as a diagram?

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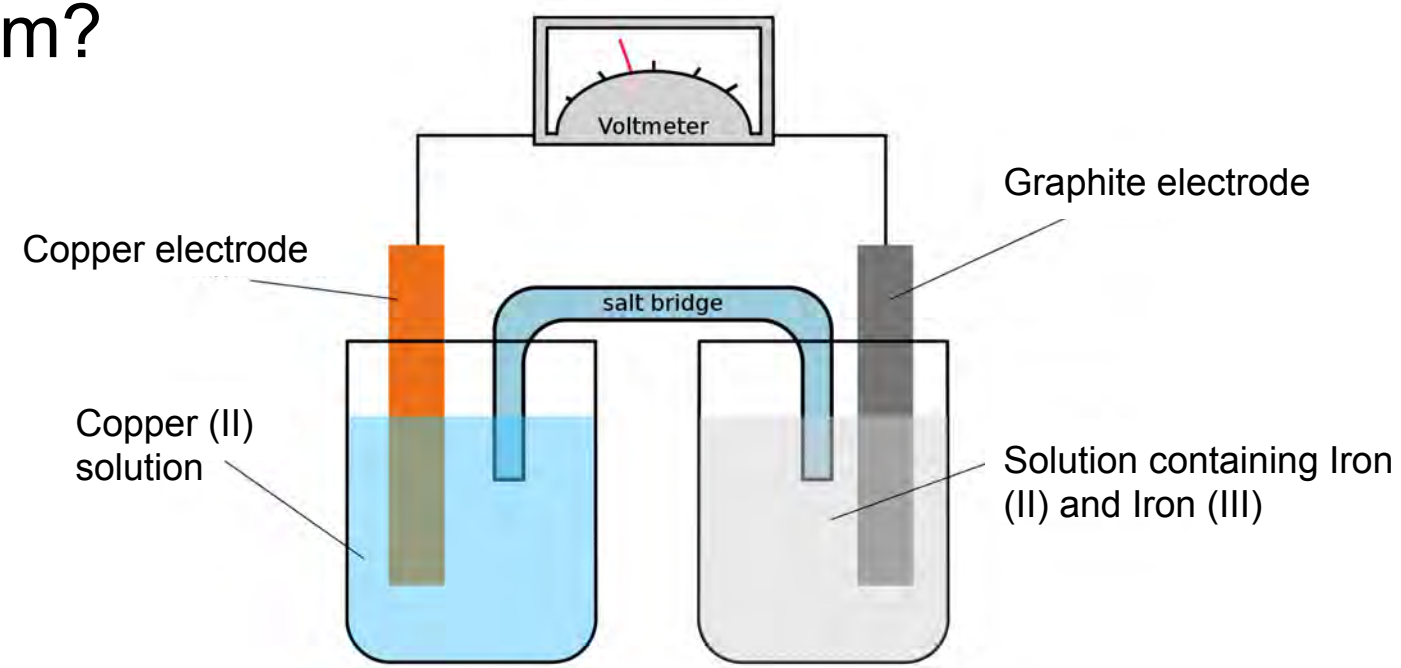

What is a salt bridge?

What is a salt bridge?

- A salt bridge allows the transfer of ions.
- It is typically a concentrated solution of an electrolyte i.e. $KNO_{3(aq)}$ that doesn't react with either half cell solution.

Why may a graphite or platinum electrode be used?

Why may a graphite or platinum electrode be used?

They are very unreactive- i.e. will not react with the half cell solutions and will not affect the voltmeter readings. Usually used in ion/ion half cells.

How do you predict which half-cell is being oxidised and which one is being reduced?

How do you predict which half-cell is being oxidised and which one is being reduced?

- The more **negative** the E^{θ} value, the greater the tendency for the system to be **oxidised**.
- The more **positive** the E^{θ} value, the greater the tendency for the system to be **reduced**.
- Hence the half-cell with the more positive E^{θ} is oxidised and the half-cell with the more negative E^{θ} is reduced.

How do you predict the feasibility of a redox reaction?

How do you predict the feasibility of a redox reaction?

- The reaction is feasible if the oxidising agent has a lower standard cell potential than the reducing agent.
- The greater the difference in E^{θ} value, the more likely the reaction is to occur.

Why may a reaction not occur?

Why may a reaction not occur?

- Non-standard conditions (298 K, 101 kPa, 1 mol dm^{-3} solutions).
- Ambient energy of the system is lower than the activation energy.

What is rusting?

What is rusting?

- Rust is an iron oxide, (usually red) formed from the redox reaction of iron and oxygen in the presence of water/moisture.
- Iron is oxidised, oxygen (dissolved in water) is reduced. The products of this redox reaction then react to form a hydrated iron oxide.

How do you prevent rusting?

How do you prevent rusting?

- To protect iron from rust, the surface needs to be separated from air and water. i.e. by keeping the metal in oil.
- Coatings can be applied to iron.
- Alloys (e.g. stainless steel) can be made to prevent rusting.